The final arrangement adopted for the preparation of the liquid is as follows. A quantity of nickel oxide is placed in a combustion tube, and reduced at about 400° by the passage of a current of hydrogen gas. The tube and contents are then cooled down to about 30°, and pure dry carbon monoxide instead of hydrogen passed through the tube without further heating it. The issuing gas is caused to pass through a Y tube surrounded by ice and salt. The lower end of the Y tube projects through the vessel containing the freezing mixture into a small flask in which the liquid collects. The gas leaving the Y tube still retains about 5 per cent. of the new body, and is therefore collected, dried, and again passed over the nickel until no more liquid condenses. The tube containing the nickel is then re-heated to 400° in a slow current of hydrogen, again cooled, and the operation recommenced. In this manner it is easy to obtain ten to fifteen grams of the liquid in each operation.

The liquid boils at 43° under a pressure of 751 mm. Its specific gravity is 1·3185 at 17°. At –25° it solidifies to a mass of needle-shaped crystals. The liquid is soluble in alcohol, and even more readily in benzene and chloroform. It is perfectly indifferent to dilute acids and alkalies, and is not attacked by concentrated hydrochloric acid. Strong nitric acid oxidizes it readily. As regards its composition, the nickel was estimated by weighing the nickel deposited on passing repeatedly through a heated tube, and the carbon by passing the vapour mixed with air over copper oxide, and absorbing and weighing the carbon dioxide produced. The following numbers were obtained :—

	I.	II.	Calculated for $Ni(CO)_4$.
Nickel ...	33·35 ...	33·37 ...	34·34
CO ...	66·60 ...	65·99 ...	65·66

Its composition, therefore, appears to be represented by the formula $Ni(CO)_4$. Its vapour density, the first density determination of a nickel compound, was determined by Victor Meyer's method at 50°. The value obtained was 6·01. $Ni(CO)_4$ corresponds to the density 5·9. At 60° the vapour was found to explode with considerable violence.

Vapour of nickel-carbon oxide, as its discoverers term it, reduces an ammoniacal solution of cuprous chloride, first decolorizing it and subsequently precipitating from it metallic copper. It also precipitates metallic silver from ammoniacal solutions of silver chloride. Chlorine decomposes it with production of nickelous chloride, $NiCl_2$, and carbon oxychloride, $COCl_2$. Bromine reacts in a precisely similar manner. The electric spark decomposes it slowly into nickel and carbon monoxide.

Experiments have also been made to ascertain the possibility or otherwise of preparing a similar compound of cobalt and carbon monoxide. It was found, however, that cobalt does not form such a compound; indeed, it is quite possible to separate nickel from cobalt by reacting with carbon monoxide in the above manner, the nickel only being removed. The metallic mirrors obtained by the decomposition of nickel-carbon oxide by heat were found to consist of unusually pure nickel, containing no traces of cobalt. They consisted of a grey metallic powder of specific gravity 8·2834 at 15°·4.

It became interesting, therefore, to ascertain the atomic weight of this pure nickel, especially in view of the recent work of Drs. Krüss and Schmidt. Accordingly, a series of three determinations were made, with the following results:—If O = 16, Ni = 58·58, 58·64, and 58·52. These numbers are sufficiently close to the value 58·74, long ago obtained by Dr. Russell, to justify the conclusion that nickel, as we have known it, is indeed a simple substance, whose atomic weight lies very near to the figure hitherto accepted—a conclusion which is further supported by the determination of the vapour density of this remarkable new compound, nickel-carbon oxide.

A. E. TUTTON.

BRITISH MUSEUM NATURAL HISTORY PUBLICATIONS.[1]

THE present Part (IV.) concludes Mr. Lydekker's "Catalogue of the Fossil Reptilia and Amphibia in the British Museum (Natural History)," the four volumes making together a work of 1247 pages. In Part I. the author records the Ornithosauria, the Crocodilia, the Dinosauria, the Squamata, the Rhynchocephalia, and the Proterosauria; Part II. contains the Ichthyopterygia and Sauropterygia; Part III. embraces the Chelonia; and Part IV. the anomalous group of the Placodontia, the Anomodontia, and the class Amphibia, including the Ecaudata, the Caudata, and the Labyrinthodontia, with supplementary notes and additions to the preceding orders. The earlier parts having been already noticed in NATURE, we shall confine our attention to Part IV.

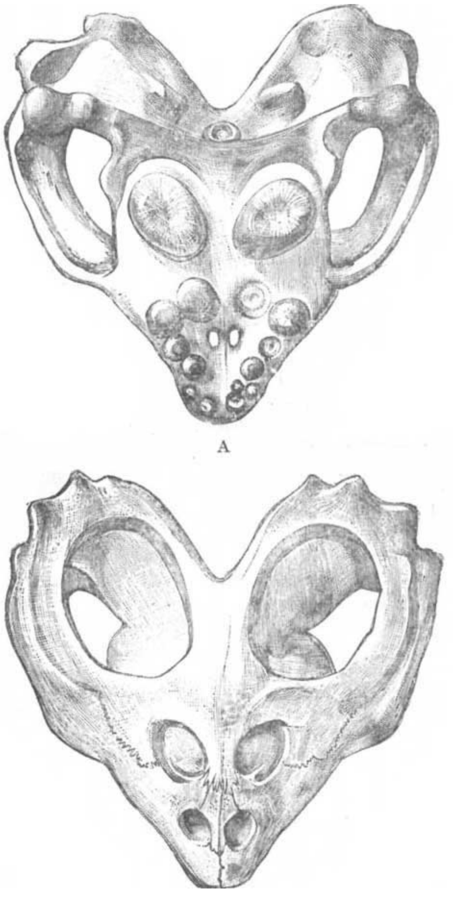

FIG. 1.—*Cyamodus* (*Placodus*) *laticeps*, Owen. A, palatal aspect; B, fronta aspect of cranium; from the Muschelkalk of Baireuth, Germany.

Amongst the rare remains of Reptilia met with in the Muschelkalk of Baireuth, Bavaria, none are of more interest than those belonging to the anomalous group of the Placodontia, the ordinal position of which is still uncertain. The skull and teeth of one of these reptiles was originally referred by Count Münster, and afterwards by Agassiz, to the class of fishes, under the genus *Placodus;* but more perfect specimens enabled Prof. Owen, in 1858, to show that this animal was really a reptile which probably fed upon shell-bearing mollusks and used its flat, broad, palate-like teeth, so thickly-coated with enamel, for pounding and crushing their shells (see Phil. Trans., 1858, p. 169).

---

[1] "Catalogue of the Fossil Reptilia and Amphibia in the British Museum (Natural History), Cromwell Road, S.W." Part IV., containing the Orders Anomodontia, Ecaudata, Caudata, and Labyrinthodontia; and Supplement. By Richard Lydekker, B.A., F.G.S., &c. Pp. 295 and xxiv. With Index to the entire Work. Illustrated by 66 Woodcuts. (London: Printed by Order of the Trustees: and sold by Longmans and Co.; B. Quaritch; Asher and Co.; Kegan Paul, Trench, Trübner, and Co., &c., 1890).

Two genera, *Placodus* and *Cyamodus*, are referred to this group, at present known only by the skull and teeth, no vertebræ or bones of the pectoral or pelvic girdles, or limbs, having been as yet discovered. Owen originally referred this singular form to the Sauropterygia, but subsequently he regarded it as belonging to the Anomodontia, in which order Seeley also places the Placodontia. The present author, however, assigns the Placodonts to no ordinal position, a course which, we think, is to be regretted. If not Anomodont reptiles, why not give them the value of an order? Surely they have as good a claim to such a position as *Proterosaurus?*

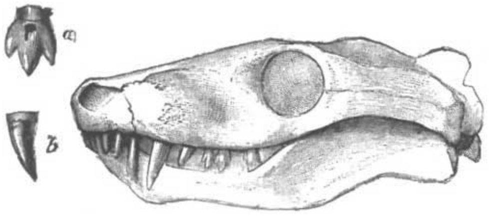

FIG. 2.—Left lateral aspect of skull of *Galesaurus planiceps*, Owen; from the Karoo beds (Triassic), South Africa. (⅓ nat. size.) *a*, an upper cheek-tooth; *b*, an incisive tooth.

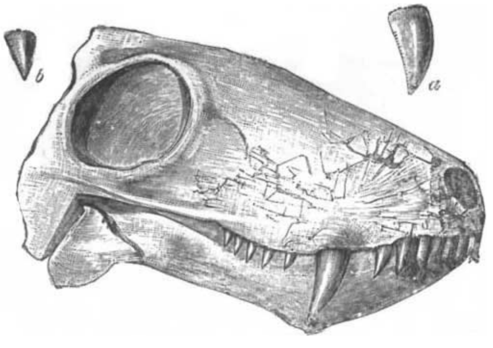

FIG. 3.—Right lateral aspect of imperfect cranium of *Ælurosaurus felinus* Owen; from the Karoo beds (Triassic), Beaufort West, South Africa. (⅔ nat. size.) *a*, upper incisive tooth; *b*, upper cheek-tooth, enlarged.

The Anomodontia, which follow next in order, are a truly Triassic group, and have been met with in Russia, India, North America, and in South Africa. It is especially from this last-named region that the British Museum collection has been most largely recruited, the majority of the specimens having been procured by Messrs. A. G. and T. Bain, Dr. Atherstone, and Sir George Grey. Quite recently, Prof. H. G. Seeley, F.R.S. (assisted by the Government Grant Committee of the Royal Society), visited the Cape, where he was most successful in obtaining a large series of reptilian remains, not yet fully worked out, but of which sufficient is already known to justify us in believing it will prove one of the most valuable additions made for years past to our National Museum.

The interest attaching to these South African Triassic rocks (if Triassic they be) lies in the fact that they have yielded evidence of one of the earliest mammals known—*Tritylodon*—represented by a most remarkable although imperfect cranium, with dentition similar to Cope's genus *Polymastodon*, from the Eocene of North America.

In the group of Anomodont reptiles are included several forms having a well-differentiated series of cheek-teeth, canines, and incisors, a character of dentition considered at one time to be peculiar to the Mammalia. Good examples of such dentition may be seen in the skulls of *Galesaurus*, *Ælurosaurus*, *Lycosaurus*, &c.

Another no less singular family, placed in this order, is that of the Dicynodontidæ, in which the surface of the palate and mandible are without teeth, the skull being provided with a pair of tusk-like maxillary teeth, growing from persistent pulps; the alveolar margins of the jaws being trenchant, and probably encased in a horny beak-like sheath, as in *Hyperodapedon.*

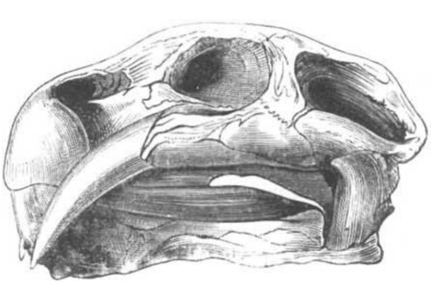

FIG. 4.—Lateral view of the skull of *Dicynodon lacerticeps*, Owen; from the Karoo series, South Africa.

Another remarkable form of Anomodont, from these Reptiliferous beds of South Africa, has been referred to the genus *Pariasaurus* by Owen. In the form of its head it is very like a huge Salamander, 8 to 10 feet in length, having a numerous and uniform series of moderately tall marginal teeth in its jaws, with swollen and narrow crowns, ornamented with a few deeply-marked flutings descending from the cutting edge, and with numerous small conical teeth on the palate. The

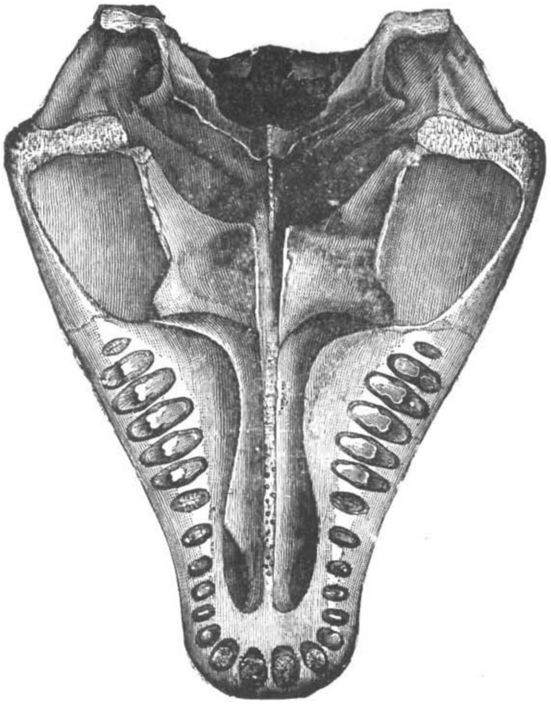

FIG. 5.—Palatal aspect of cranium of *Empedias molaris*, Cope; from the Permian of Texas, North America. (¼ nat. size.)

skull is deeply channelled on its surface, as in the Crocodilia and the Labyrinthodontia.

From the flattened wearing away of the crowns of the teeth, Prof. Owen has suggested it was a vegetable-feeding reptile. The vertebræ of *Pariasaurus* are notochordal, frequently having intercentra present, and there are not more than two vertebræ united to form the sacrum.

The Permian rocks of Texas have yielded to Prof. Cope a most remarkable genus of Anomodont reptiles, named by its describer *Empedias molaris*. The dentition forms an uninterrupted series without a distinct tusk, the incisors differing but little from the cheek-teeth in form, each tooth having a more or less distinct transverse edge. The teeth are about fifty-six in number.

The genus *Naosaurus*, also from the Trias of Texas, makes us acquainted with a very curious reptile, in which the neural spines of the vertebræ are of most enormous height, and each spine has often as many as six paired horizontal processes at intervals produced from its sides.

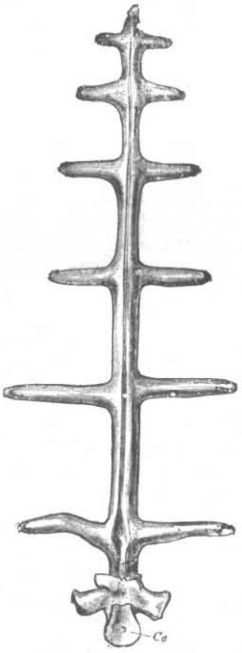

FIG. 6.—Anterior view of a dorsal vertebra of *Naosaurus claviger*, Cope; from the Permian of Texas. (⅙ nat. size.) *Ce*, centrum.

This reptile when living must have had an enormous dorsal crest, like some monstrous newt, rising from its back, but it is difficult to conceive any advantage which its owner could possibly derive from such an unwieldy appendage.

Turning to the Amphibia, one cannot fail to be struck by the similarity in the form of the cranium, and its external ornamentation, in the Labyrinthodontia and the Crocodilia. The body is also long, usually lacertiform, and the feet pentadactyle; a bony thoracic buckler and bony scutes are frequently present on the ventral aspect of the body. Doubtless these old Triassic reptiles were ancestrally related to the later Crocodilia, as well as to other and higher forms of Vertebrata.

Teeth in the Labyrinthodonts are usually present on the palatines and vomers, and more rarely on the pterygoids; and there is very generally an ossified sclerotic ring to the orbit. The vertebræ exhibit considerable variation in condition, being amphicœlous, and fully ossified in some instances, or with a notochordal canal, or with large intercentra and the centra represented by paired lateral pieces (pleurocentra) in others.

The parietal foramen is always present in the cranium, and in the Mastodonsauridæ the occipital condyles are well ossified.

The Trias of Würtemberg has yielded the finest known examples of these Labyrinthodont reptiles, quite recently described and figured by Dr. Fraas; but the most complete skeletal remains of Amphibia have been obtained from the Gaskohle (Lower Permian) of Bohemia by Dr. Anton Fritsch, of Prague; others from Germany by Prof. Credner, of Leipzig; and by Prof. Gaudry from the Lower Permian of Autun. The best examples in the collection are those of *Archægosaurus* from the Lower Permian of Saarbrücken, and of *Loxomma* from the Coal-measures of Coalbrookdale and Scotland.

To the Ecaudata (frogs and toads) little interest attaches in a palæontological sense, as no tailless forms of Amphibia are known earlier than the Miocene period; but good examples of these have been obtained from the Brown-Coal of Rott, near Bonn, and from the Fresh-water Tertiary Limestone of Oeningen, which also yields the remains of *Cryptobranchus scheuchzeri*, closely related to the giant salamander now living in the fresh-waters of Japan.

Contrasting for a moment the MAMMALIA with the REPTILIA, while many genera of the former, such as *Dinotherium*, *Mastodon*, *Machairodus*, *Phenacodus*, *Palæotherium*, *Anthracotherium*, *Taxodon*, *Sivatherium*, *Dinoceras*, and others, have died out, *eight entire orders* of REPTILIA and AMPHIBIA, embracing more than 200 genera, have all disappeared. This is the more readily understood when we consider the comparative periods of geological time during which the Mammalia and Reptilia have respectively flourished; for whilst it is true that the earliest known forms of Mammalia made their appearance as far back as the termination of the Triassic period, yet during the whole of the succeeding Jurassic and Cretaceous periods their numbers were few and their forms quite insignificant; and it is not until we arrive at Eocene times that the Mammalia commence to occupy anything like a prominent position in the animal kingdom. On the other hand, the Amphibia began to be abundant as early as the Coal period; and the Reptilia (ushered in by *Proterosaurus*) in the Permian attained a maximum development both in size and numbers in the Lias and Oolites, whilst the Mammalia were yet only in the incipient stage of their development.

Great credit is due to Mr. Lydekker for the manner in which he has performed the task of preparing these Catalogues for the National Collection, a work which will doubtless prove of extreme value to students of comparative anatomy and to workers at a distance who desire to know what objects in any particular family or genus the Museum possesses.

We could wish that greater distinctness had been given in printing these Catalogues to the important fact of particular specimens being the ones which are known as "types," and which are the actual ones that have been figured and described; where this is mentioned it does not catch the eye at once, as it should do. We would advocate the placing of such information in a separate line; and, if possible, they should be marked prominently by the use of *special type*. Perhaps the word "type" or "figd." could be inserted in black letter and begin a separate line.

Again, the formation and locality are hardly prominent enough, and under each genus we would like to see the "range in time" and also the "geographical distribution" given as a separate paragraph.

We hope this series of Catalogues, so helpful to all real workers, may be continued and completed for every group in the Geological Department. The Trustees could not perform a more useful service to science than by urging forward the issue of these works in every Department of the Museum.